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Analysis of the Lyrids' meteor stream structure for long timeslots

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Abstract

Lyrids' structural parameters (luminosity function parameter r of meteors distribution magnitudes, the S parameter distribution of meteoroids in the mass flow, zenithal hour number (ZHR)) are determined by visual observations made in the 1900–2007 interval. The minimal value of S is equal to 1.54 ± 0.02 and corresponds to the Sun longitude $32.19° \pm 0.04°$. Lyrids' activity profiles as ZHR depending on the Sun longitude (L) were constructed for studying the flow activity. ZHR averaging for the individual values was held according the observation in 1900–1963, 1900–2000, 2001–2007 and 1900–2007. The peak position for all groups is the same within the error and equal to $32.326° \pm 0.107$. Two periods of Lyrids activity were revealed: a period which is close to 60 years; and s period of about 10–12 years.

Keywords: Meteoroids; Meteoroid streams; Small bodies of the solar system; The orbits evolution

1. Introduction

At the present time solutions for the questions connected with the structural parameters of meteor showers evolution are important and essential (Sokolova et al., 2013, 2014). The Thatcher 1861 I comet, with an orbital period of 415 years, is the parental comet of Lyrids. Lyrids are observed from 16 to 25 April, and have a low annual activity. However, in some years, the flow activity increases, and it is not associated with the comet's approach to the Sun. Four bursts of the flow activity have been reported and described in the literature in 1803, 1922, 1946 and 1982. Authors' works such as (Arter and Williams, 1995, 1997, 2002), and also articles such as (Emelyanenko, 2001) and (Rendtel and Arlt, 2007) which were dedicated to the study of Lyrids' stream activity. In these papers the 12-year cycle of the stream activity and its possible causes, primarily related to Jupiter's influence on the meteoroids' motion in the stream, are discussed. Another interesting point is that Lyrid' meteor stream was registered in the year 687 B.C. and has a quite low activity. However in some years the activity of Lyrid' meteor stream greatly exceeds its mean value. These spikes take place with a period of 12 years. The activity spikes of Lyrid' meteor stream cannot be explained within the approximation of parent comet close to the Earth, since its period is about 400 years. The observed periodicity can be explained by certain circular rotation of the Lyrid' meteor stream structure.

Thus, as a rule, the main research method is the simulation of possible scenarios of Lyrids' meteoroid swarm formation and its further evolution. The study of the shower structure by visual observations, obtained over a long time interval, allows us to clarify the period of the periodic activity of the Lyrids.

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